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ABSTRACT

This study investigated whether attitudes towards mathematics as exhibited by a group of preservice elementary teachers could be improved through remedial mathematics instruction. Previous studies have shown mathematics anxiety to be widespread among elementary school teachers, a population that is predominately female. Alleviating mathematics anxiety among future teachers is viewed as necessary if mathematics achievement among students is to be increased since teachers are seen to be most knowledgeable and to perform best in those areas they like most. Twenty-six junior and senior elementary education majors participated in the study. Attitudes towards mathematics were not significantly improved by a 13-week treatment program with this group of preservice teachers, but positive change scores were obtained. An underlying assumption of the investigation, that achievement and attitude in mathematics are positively correlated, failed to be supported by the data. The limit of time for treatment is seen as a likely limitation of this study. Changes in attitudes toward a field of study are projected to occur after a longer period of time than used in this investigation. (MP)

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A STUDY OF ATTITUDE - TREATMENT INTERACTION IN MATHEMATICS WITH PRESERVICE ELEMENTARY SCHOOL TEACHERS

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Introduction

There has been growing concern among mathematics educators for the phenomenon termed "math anxiety." Math anxiety is a combination of poor attitudes toward mathematics and low expectations for one's own achievement in mathematics. Math anxiety inhibits the acquisition of mathematics skills and processes, but the converse is also true: failure to acquire requisite skills and processes for the successful study of mathematics often results in math anxiety. The work of Shelia Tobias (1978) indicates both the magnitude and the effect of this phenomenon and its resultant condition, math avoidance. She states that surprisingly large numbers of people manifest this anxiety, and though women are particularly susceptible, men are also afflicted. This condition can severly limit educational and career possibilities. The self-defeating attitudes generated by the anxiety preclude the level of achievement in mathematics necessary for study in most fields of science and engineering. Other studies have substantiated the critical relationship of attitude and achievement in mathematics. In general, poor attitudes are reflected in poor grades (Campbell and Martinez-Perez, 1977; Sells, 1978, Sepie and Keeling, 1978; Brush, 1978; Fennema, 1979).

Statement of the Problem

On the basis of previous research showing achievement and attitude in mathematics to be positively correlated, this study was designed to investigate whether attitudes toward mathematics

as exhibited by a group of preservice elementary teachers could be improved through remedial mathematics instruction in the area of their assessed weaknesses. The research hypothesis stated that there would be a significant difference in mean scores on attitude toward mathematics among the cells of a 2 x 2 matrix of groups comprised of remedial instruction/no remedial instruction by math methods course/language arts method course.

Significance of Problem

While Tobias (1978) and Sells (1978) have stated that there is a disproportionately high incidence of math anxiety among women, Pearson (1980) states that the phenomenon is "disturbingly widespread" among a population that is predominately female--elementary school teachers. Empirical studies have shown that teachers, like any learners, demonstrate a direct, positive relationship between attitude and achievement. Campbell and Okey (1977) have shown that this relationship exists between teacher's process-skills achievement and their attitudes toward the skills. Teachers are most knowledgeable and perform best in those areas that they like--and conversely. Therefore, a high incidence of math anxiety among elementary teachers is of grave concern, particularly in an era of renewed emphasis on the traditional third "R".

Furthermore, growing literature in teacher effectiveness research shows that individual teachers exert the major

influence on student achievement, a greater influence than methods or curriculum (Good, 1979). The most effective math teachers have been shown to exhibit the following behaviors: 1) clarity and precision in presentation--using more relevant examples and fewer vague terms--and 2) enthusiasm and confidence with the subject (Good and Grouws, 1979; Everton, Emmer, and Brophy, 1980). Unfortunately, these are behaviors that are antithetical to those exhibited by math-anxious teachers.

As educators attempt to improve the mathematical competence of our youth, it has become painfully apparent that math anxiety can be a contagious as well as debilitating condition for which some teachers are "carriers." Therefore alleviating math anxiety among future elementary teachers is necessary if we are to increase math achievement among students.

Hypothesis

H_o: There is no significant difference in mean scores on attitude toward mathematics among the cells of a 2 x 2 factorial design comprised of remedial instruction/no remedial instruction by math methods course/language arts methods course.

Procedures

Subjects. Twenty-six junior and senior elementary education majors from the University of Montevallo in Montevallo, Alabama participated in the study. All were enrolled in one of two methods courses for elementary education majors, math or language arts.

The University of Montevallo is a small public university in the approximate geographic center of Alabama. It enrolls about 3,000 students from a relatively homogeneous educational background, most of whom come from within the state.

Method. A pretest, posttest, control group design was used for the study. An experimental and a control group were randomly assigned from the enrollments of the two methods courses. The resultant four groups used in the study were identified as follows: G1 (Exp/LA), G2 (Exp/Math), G3 (Con/LA), G4 (Con/Math). All students were pretested on attitude toward mathematics using a twelve-scale semantic differential. Next, they were pretested on achievement in mathematics on an instrument modeled after typical test items in 7th and 8th grade math texts and the math subtests of the 8th grade California Achievement Test. Test material covered the four operations with positive rational numbers.

The experimental group was divided into two study sessions to accommodate scheduling conflicts. For thirteen weeks each session met once a week for one hour and received individual and group instruction and assignments from the researcher. The instruction systematically covered the areas of weakness as assessed by the pretest.

At the end of the semester posttesting on attitude was measured by the semantic differential and posttesting on achievement was measured with a parallel form of the achievement test.

Results

In an attempt to increase statistical precision, the initial analysis used with the data was analysis of covariance. The pretest achievement score was used as a covariate since the literature indicated that achievement was related to attitude. ANOVA on the covariate affirmed the requisite assumption of independence of covariate and treatment. The Pearson correlation coefficient indicated, however, that the covariate was not significantly correlated with the dependent variable. Therefore the use of ANCOVA was not deemed appropriate since the loss of a degree of freedom for the covariate diminished the efficiency of the analysis.

Consequently, ANOVA was used with the data to determine if change scores in attitude among the groups were significantly different. No significant differences were indicated for either the interaction or the main effects. Therefore the null hypothesis was retained. Even though differences were not statistically significant, it is interesting to note that the highest mean for attitude was in the control group taking language arts methods. While this difference could be caused by chance alone, it could also indicate that for these subjects attitudes toward mathematics remain higher when students do not come into contact with mathematics at all. Table 1 shows means and standard deviation by groups.

Table 1

Attitude Toward Mathematics Scores

Means and Standard Deviations

Group	Scores					
	Pre		Post		Gain	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
G1 (Exp/LA)	59.89	11.55	63.89	12.12	4.0	8.96
G2 (Exp/M)	57.60	16.83	61.60	7.40	4.0	14.58
G3 (Con/LA)	52.38	18.88	62.75	12.42	10.38	7.65
G4 (Con/M)	72.00	5.60	72.50	5.45	.5	.58

Mean change scores in achievement by group did show a significant difference ($p < .003$), however, with those students enrolled in math methods and receiving treatment scoring significantly higher than those in the language arts method course. Table 2 summarizes the results of the analysis of variance. Computation of eta^2 yielded .52 indicating practical significance of the treatment.

Table 2

Analysis of Variance Summary Table Comparing

Mean Mathematics Achievement Gains Among Groups

Analysis of Variance					
Source	DF	SS	MS	F	P
Between Groups	3	2829.461	943.153	6.605	.003
Within Groups	18	2570.357	142.797		
Total	21	5399.818			

Table 3 reports specific differences among groups as found with post hoc comparisons using Tukey's Honestly Significant Difference. The critical HSD = 19.10. Group 2 (Exp/Math) was found to be significantly higher than Group 1 (Exp/LA) and Group 3 (Con/LA).

Table 3

Pairwise Comparison of Mean Change Scores

Mathematics Achievement

Comparison	Difference of means
G2 - G1	28.46*
G1 - G3	2.00
G4 - G1	11.47
G2 - G3	30.46*
G2 - G4	17.00
G4 - G3	13.47

*significant, $p<.05$

Conclusions

Attitudes toward mathematics were not significantly inproved by the 13-week treatment with this group of preservice elementary teachers. Positive change scores were obtained, however.

One of the underlying assumptions in this study, that achievement and attitude in mathematics are positively correlated, failed to be supported by the data. In fact, the highest mean change score in attitude was in the control/language arts group,

the group with the lowest posttest score in achievement . Though this difference was not great enough to be statistically significant, the fact that it was a relatively large positive difference is a cause for questions. One possible explanation could be that the language arts methods course, with its emphasis on positive classroom behavior, influenced students to generalize more positive attitudes to the field of mathematics without concomitant, and possibly frustrating, experiences in mathematics.

Even though the data did not support the research hypothesis, the length of time that the treatment was administered was very likely a limitation of the study. Attitudes toward a field of study are often formed over a long period of time, and significant changes in those attitudes may take a longer period of time than was used in the study. However, attitude improvement could logically follow the increased facility with mathematics skills exhibited in the experimental/math methods group.

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